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Vol. 43 No. 8

BULLETIN

OF THE

TORREY BOTANICAL CLUB

AUGUST, 1916

The development of the embryo sac and embryo of Cooperia Drummondii*

MARGARET B. CHURCH

(WITH PLATES 22 AND 23)

The following study of the embryo sac and embryo of *Cooperia Drummondii* was undertaken with the idea that a further knowledge of the embryo sac of the Amaryllidaceae would doubtless be of value and interest, since little or no work of this kind has been attempted recently in connection with this family.

The geographical range of *Cooperia Drummondii* extends from the prairies of southern Kansas southwest into northern Mexico and as far west as New Mexico. The leaves of a mature plant are glabrous, the very narrow grass-like blades arising from coated, subglobose bulbs which are six to eight inches below the surface of the ground. The roots are coarse and unbranched except when injured at the tip. The flower scape varies from pale green at the base to yellow at the perianth. Its veins are a distinct rose color. The flower at the time of opening is creamy white with the tips of the lobes of the salverform perianth sometimes rose-colored. It becomes pure white when in full bloom and on withering gradually changes to deep dull rose. No difficulty was encountered in obtaining seed in the greenhouse from self-pollinated flowers.

Cooperia Drummondii is popularly known as "Rain Lily," because the flower scapes shoot up and bear blooms very rapidly

[The BULLETIN for July (43: 343–396. *pl. 21*) was issued August 12, 1916.]

* Contribution from the Botanical Laboratory of Brown University.

after a heavy shower of rain. In contrast it is worth noting that *Habranthus* [*Zephyranthes*] *gracilifolius* β *Boothianus* breaks the sheath three days before the flower opens (Lindley, 7). The flowering period of *Cooperia Drummondii* in the vicinity of Austin, Texas, usually includes the last week in April and the first week in May.

The material for the study of the development of the embryo sac was furnished to the writer by Professor H. H. York, who collected it on the campus of the University of Texas. For the study of the development of the embryo, bulbs were secured from the above mentioned place, and were grown in the greenhouse at Brown University. Flemming's weaker and stronger solutions, chromo-acetic acid, alcoholic and aqueous picro-acetic acid were used in general for killing and fixation. Aqueous picro-acetic gave the best results in the case of the embryo sac and the mature embryo. The following additional solutions were tried in an attempt to prevent the shrinking of the immature embryo during the process of killing and fixation: (1) 2 c.c. of a one per cent. aqueous solution of acetic acid, 11 c.c. of a one per cent. aqueous solution of osmic acid and 11 c.c. of water for fifteen minutes; (2) a one per cent. aqueous solution of osmic acid for fifteen minutes; (3) a one per cent. aqueous solution of osmic acid for three minutes, followed by twenty-four hours in Schaffner's chromo-acetic; (4) a solution of osmic acid and acetic acid in the proportions mentioned above for three minutes, followed by Schaffner's chromo-acetic for twenty-four hours; and (5) a two per cent. aqueous solution of acetic acid for twenty-four hours. The two per cent. aqueous solution of acetic acid proved to be a perfect fixing agent for the immature embryos, especially if the individual ovules were dissected out from the ovary immediately before fixing. Dehydration and imbedding were carried on in the usual way, except in the case of embryos large enough to be dissected out of the ovule. Here the laying of the material in a certain position in order that sectioning might be in the right plane was facilitated by staining the embryos *in toto* by means of a dip into erythrosin before dehydration was completed, and the subsequent use of the binocular microscope and substage illumination as will be described. The binocular microscope was unscrewed

from its stand and placed upon a ground glass plate below which in a convenient compartment was an electric light bulb. A glass plate, bearing the imbedding ells, was placed on the arms of the stage. The light from the electric bulb readily made visible the gross structure of the embryo, so that the orientation of the object could be positively determined. Care was taken not to overheat the lenses of the binocular by leaving the electric bulb lighted for too long a period. The imbedding was done therefore quite rapidly. Serial sections 10–12 μ in thickness were cut. Delafield's hematoxylin; Haidenhain's iron-alum haematoxylin with fuchsin, erythrosin or Orange G; thionin with erythrosin; and Flemming's triple stain were used. The last gave the best results.

Very early in the development of the ovule, the primitive archesporial cell, which is hypodermal in origin, may be distinguished from the surrounding somatic tissue by its size, its granular content and its prominent nucleus (FIG. 1). Two hypodermal cells in one ovule were noted in five examples out of one hundred and forty-six ovules examined (FIG. 2). It was not possible to follow the subsequent development. Guignard (4) reported this condition in *Ornithogalum pyrenaicum*, and similar instances have been found in an increasing number of the Liliaceae. See Coulter and Chamberlain (1), Lechmere (6), and McAllister (8, 9). At this time the integuments of the ovule are not visible. The archesporial cell develops at the expense of the surrounding nucellus into a large oblong cell, which stands with its longer axis parallel to that of the ovule (FIG. 3). No tapetal cells were observed. The absence of a parietal tissue occurs among some of the close relatives of the Amaryllidaceae, as in *Allium*, *Hemerocallis*, *Lilium*, and *Erythronium* of the Liliaceae; and in *Sisyrinchium iridifolium* and *Iris stylosa* of the Iridaceae (Coulter and Chamberlain, 1).

Megaspore formation takes place in the way usual for the Liliaceae. The archesporial cell becomes directly the one-celled stage of the embryo sac (FIG. 3). It was not possible to follow out the behavior of the chromosomes in any of the divisions of the embryo sac nuclei. Since the mode of development of the embryo sac of *Cooperia Drummondii* is similar to that of *Ery-*

thronium (Schaffner, 11), *Lilium* and *Tulipa Gesneriana* (Treub and Mellink, 12) and other Liliaceae, we may for the present assume that the reduction division occurs with the division of the one-celled stage and is completed when the four-nucleate embryo sac is formed (FIGS. 4, 5). By a division of the four nuclei the eight-nucleate sac results (FIG. 6).

At the time of fertilization the two polar nuclei are in the chalazal half of the sac, the antipodals near the chalaza, and the egg cell and the synergids opposite the micropyle (FIG. 6). The polar nuclei have a very thin protoplasmic content, although their nucleoli stain heavily. The three antipodals are at first arranged in a pyramid whose apex points toward the micropyle. Just before fertilization they become rearranged in a row, parallel with the longitudinal axis of the chalazal end of the embryo sac; while after fertilization they generally move again, this time to form a pyramid with its apex directed toward the chalaza. The antipodals stained very deeply in all of the combinations of stains that were used. This may be indicative of disintegration. The synergids have dense but vacuolated protoplasm. The egg cell is large and pear-shaped with a large round nucleus. It is directly in front of the micropyle. The dense protoplasm of the egg is less vacuolated than that of the synergids.

The nucellus at the time of fertilization has been largely absorbed or digested except for a thin layer of cells about the micropylar portion of the sac and a small mass of cells located at the chalaza and almost wholly deprived of protoplasm. The antipodals show a marked tendency to enlarge, and in numerous instances increase so as to almost equal the egg cell in size. This tendency toward enlargement persists even after fertilization, when the partial development of the embryo has taken place. Ordinarily, however, the antipodals have almost disintegrated when the embryo has become two-celled. The two polar nuclei, which are in close contact at maturation, fuse at the time of fertilization. A few examples of triple fusion were observed (FIG. 8). Ernst (2) has observed this condition in *Paris quadrifolia*. Further, it has been observed in other Liliaceae: as in *Trillium grandifolium;* in species of *Lilium*, of *Fritillaria*, and of *Tulipa;* and in *Endymion nutans* (Coulter and Chamberlain, 1). The synergids disappear at fertilization.

Following fertilization the endosperm nucleus divides, and by subsequent mitotic divisions a number of free nuclei, apparently without nuclear walls, are formed (FIG. 17), which are imbedded in the cytoplasm lining the wall of the sac and surrounding the embryo. Free nuclei are found in *Alisma Plantago* (Schaffner, 10), *Leucojum vernum* (Hofmeister, 5), and *Xyris indica* (Weinzieher, 13). Eventually these nuclei become separated by cell walls, which are at first laid down so as to include several nuclei in each lumen (FIG. 18). Later these multinucleate cells divide in such a manner that a single nucleus becomes enclosed within a lumen. The cells divide by amitosis after the walls are laid down. Several cases have been noted where endosperm formation was lacking. In connection with endosperm development in *Cooperia Drummondii* the description of endosperm formation in *Leucojum vernum* as given by Hofmeister (5) is of interest: ". . . the kernels in the inner fluid of the embryo sac increase in size and number; most of them lie now against the wall of the embryo sac; . . . they unite with the cells which fill up the space of the embryo sac. The lower part of the nucellus is pressed continually outward by the growing endosperm as the seed ripens."

At first it was impossible to kill and fix the early stages of the embryo. This difficulty was due to the fact that a suitable killing and fixing agent which would not cause great shrinkage of the protoplasm in these particular stages was not known. Therefore free hand sections or sections cut on a freezing microtome were used. The working out of the anatomical details of the developing embryo becomes possible with the use of a two per cent. acetic acid in water solution as a killing and fixing agent.

After fertilization the oöspore continues to occupy the same position as the oösphere. It enlarges (FIG. 7) and soon divides by a transverse wall (FIG. 9). Soon after the first division of the oöspore, the two-celled proembryo is in contact with the nucellus at the micropylar end of the embryo sac, and a little later is firmly attached at the same point. The basal cell of the proembryo develops into a suspensor, while the free terminal cell gives rise to the embryo proper (FIG. 10). The second cell division of the proembryo occurs in the basal cell, resulting in the

formation of a two-celled suspensor. Further cell divisions in the suspensor have not been observed. A number of examples were found where the suspensor consisted of but a single cell. Following the division of the basal cell, the free terminal cell divides first in a plane parallel with the longitudinal axis of the proembryo, forming the two-celled embryo (FIG. 11). The four-celled stage results from radial walls perpendicular to the first (FIG. 12).

From the four-celled stage by repeated division arises a spherical mass of cells (FIGS. 13, 14), on one side of which develops a niche or indentation (FIG. 15). This niche is the point where the shoot primordium will arise, while the cotyledon differentiates off from the rounded top, and the hypocotyl from the cells just above the suspensor of this immature embryo. In one instance this niche in an early stage was covered with a thin cell-like transparent membrane (FIG. 16). Later stages are shown in FIGS. 19 and 20.

The structure of the mature embryo may be seen in FIGS. 22 and 23. In relief a scarcely protruding pocket protects the leaf primordia by surrounding their outer surface as they lie against the base of the cotyledon. This is the "cotylar" sheath, corresponding to the sheath of a monocotyledonous leaf. This sheath has no vascular system and is very simple in structure. The long spindle-shaped cotyledon is succulent and projects into the mass of the endosperm (FIG. 21), where like a haustorium it absorbs food for the development of the embryo by means of a thin-walled row of parenchymatous cells running parallel with the longitudinal axis of the embryo. This strong development of the cotyledon is assumed to be in itself indicative of richness of endosperm development, and is, according to Goebel (3), characteristic of plants such as *Leucojum* and *Narcissus*.

The suspensor, varying in the number and arrangement of its cells, still holds the embryo in position at maturity.

The number of leaf primordia developed at the time the seed is ripe depends on the individual embryo, influenced as it is by various conditions of internal and external factors. No cases have been noted where the first leaf is undeveloped at the end of the same period, but the development and size attained by such leaf primordia in a mature embryo is not at all constant. The

leaf base of *Cooperia Drummondii*, like that of *Leucojum* and *Narcissus* (Goebel, 3), is closed. The primary root arises from the base of the hypocotyl and developing downward is protected by a well-developed root cap even as early as at the maturity of the seed.

In conclusion it may be of interest to contrast Hofmeister's description (5) of embryo sac and embryo development in *Amaryllis longiflora* with that of *Cooperia Drummondii*. They are almost entirely dissimilar. Hofmeister states that *A. longiflora* (*Hippeastrum solandriflorum*) is the only member of the Amaryllidaceae having irregular megasporangium formation. Just what he had in mind the writer does not dare to say, as no figures are given and his interpretation of the embryo sac was not that of present-day botanists. In regard to *Cooperia Drummondii* the statement may again be made that the embryo-sac development is without doubt regular, as compared with its near relatives.

In *Amaryllis longiflora* endosperm formation is sparing. The endosperm cells are displaced by the embryo before they become united into a compact tissue; while *Cooperia Drummondii*, as has been shown, has a firm, abundant and well-developed endosperm tissue. The embryo of *Amaryllis longiflora* is spindle-shaped in the region of the root and plumule but the cotyledon is bent and consequently knee-shaped, where that of *Cooperia Drummondii* grows straight upward forming a regular, spindle-shaped body except in individual instances where too much externalpres sure is exerted by earlier developed or more rapidly growing ovules.

This paper represents in part work undertaken by the author during the years 1912–1914 for the degree of Master of Arts at Brown University. The writer begs to acknowledge the assistance given by Professor Harlan H. York, of the Botanical Deaprtment of Brown University, and the courtesies of all others who may have made any helpful suggestions whatsoever.

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Explanation of plates 22 and 23

All figures except where noted are Zeiss camera lucida drawings from microtome sections. A Leitz compound microscope was used for all drawings. In some cases the scale of magnification is designated; in other cases the ocular and objective combinations are given.

FIG. 1. Archesporial cell, × 310.

FIG. 2. Ovule with two archesporial cells, × 300.

FIG. 3. Uninucleate embryo sac, × 310.

FIG. 4. Two-nucleate embryo sac, × 200.

FIG. 5. Four-nucleate embryo sac, × 110.

FIG. 6. Eight-nucleate embryo sac, × 150.

FIG. 7. Fertilized egg and pollen tube nucleus from fresh material; 1 ocular, 7 objective.

FIG. 8. Fused polar nuclei and pollen tube nucleus, × 600.

FIG. 9. Proembryo, two-celled and as yet unattached; 4 ocular, 7 objective

FIG. 10. One-celled embryo with suspensor and endosperm, from free-hand section of fresh material; 4 ocular, 7 objective.

FIG. 11. Two-celled embryo, from fresh material cut on freezing microtome, × 310.

FIG. 12. Four-celled embryo, from fresh material cut on freezing microtome, × 130.

FIG. 13. Longitudinal section through young embryo, from fresh material cut on freezing microtome, × 150.

FIG. 14. Outline of young embryo and suspensor with endosperm at one side, from free-hand section of fresh material; 4 ocular, 7 objective.

FIG. 15. Outline of embryo with suspensor, showing niche where growing point is developing, from free-hand section of fresh material; 4 ocular, 7 objective.

FIG. 16. Outline of embryo with suspensor, showing further differentiation of a growing point over which is a transparent cell-like membrane; 4 ocular, 7 objective.

FIG. 17. Free nucleus from endosperm; cytoplasm in which nucleus is imbedded not shown in drawing. Oil immersion.

FIG. 18. Cell walls being laid down between free nuclei of endosperm; walls warped by plasmolysis; diagrammatic, × 60.

FIG. 19. Outline of embryo, showing differentiation of root, sheath, plumule, and cotyledon regions, × 70.

FIG. 20. Outline of immature embryo, × 60.

FIG. 21. Diagram of mature seed, showing seed coats, endosperm, and embryo fitting loosely in the endosperm.

FIG. 22. Mature embryo, dissected out of ovule; 2 ocular, 1 inch Beck objective.

FIG. 23. Longitudinal section through mature embryo, × 150.

Notes on plants of the southern United States—II

FRANCIS W. PENNELL

In the first series of these notes, published in the February Bulletin of this year, there was given a tentative revision of the genus *Commelina*. The treatment of species there presented differed widely from current treatments and should probably have been preceded by a fuller introductory statement. A summary of the conclusions reached may therefore be in place.

Commelina communis L. is the common introduced weed of the northeastern states. Both *Commelina longicaulis* Jacq. and the little-known *C. caroliniana* Walt. have passed as *C. nudiflora* L., but, as is shown on page 96, the latter specific name must be retained for a plant of another genus, *Aneilema nudiflorum* (L.) Kunth. Strangely enough the Linnean *Commelina nudiflora* had been perpetuated in the names of two species belonging to different genera. Linnaeus's description of his *Commelina virginica* is clear and diagnostic, and leaves no doubt that the plant he was considering is that we have been calling *C. hirtella* Vahl. But the plant which has been separated in recent floras, by reason of having its capsule three-celled, as *C. virginica*, is but a state or condition of *C. erecta* L. *C. crispa* Wooton and *C. angustifolia* Michx. are continued as species but are very near, possibly not distinct from, *C. erecta*. *Commelina elegans* HBK. is a widespread species of tropical America.

In the present paper further noteworthy records, based upon my southern collections of 1912 and 1913, are given, and revisions are made of a portion of the genus *Schoenocaulon*, and of the *Nemexia* subgenus of the genus *Smilax*.

MISCELLANEOUS SPECIES

CAREX GLAUCESCENS Ell.

This species was listed in the first series of these Notes (p. 95) as *C. verrucosa* Muhl., a later name. See Mackenzie; Small, Fl. SE. U. S. ed. 2, 1324. 1915.

PLEEA TENUIFOLIA Michx.

Moist sandy soil in pine-land, Winter Park near Wilmington, New Hanover County, North Carolina, October 16, 1912, *4917*.

YUCCA GLAUCA Nutt.?

As compared with the prevalent growth of this widespread species, plants collected near Dallas, Texas (*Reverchon 4029, 4029A, F. W. Pennell 5407*), apparently differ as follows:

Leaves thickened, rigid, usually conspicuously fibrillose. Upper bracts ovate, acute, pale, with broad white margins. Capsule 50–60 mm. long, oblong, not or scarcely constricted. Seeds flat, 9–10 mm. long. 1. *Y. glauca* Nutt.

Leaves thinner, shorter, dull-green, weak-tipped, short-fibrillose above, more fibrillose at base. Upper bracts broadly lanceolate, acuminate, brown, with narrower white margins. Capsule 30 mm. long, oblong-ovoid, evidently constricted about the middle Seeds more turgid, 6 mm. long. 2. *Y.* sp.

Full identification of the doubtful plant is left for someone more conversant with this group.

GYROTHECA TINCTORIA (Walt.) Salisb.

Moist open pine-land, north of Abita Springs, St. Tammany Parish, Louisiana, > August 14, 1912, *4196*.

BLEPHARIGLOTTIS CONSPICUA (Nash) Small.

Moist sandy open pine-land, Pass Christian, Harrison County, Mississippi, > August 27, 1912, *4364*.

IBIDIUM BECKII (Lindl.) House.

Moist deciduous woodland, Catalpa, West Feliciana Parish, Louisiana, > August 21, 1912, *4282*.

SCHOENOCAULON A. GRAY IN SOUTHERN TEXAS

Two species of this genus, hitherto confused, may be distinguished as follows:

Base of stem scarcely or not fibrous-coated. Leaves 3–5 mm. wide, slightly or not glaucous, shorter than the scape. Scape stout. Inflorescence 15–20 mm. thick. Bracts rounded. Perianth-segments oblong-ovate, nearly membranous, with broad scarious margins, crenulate. Filaments stout, much dilated, 5–7 mm. long. Styles 1–2 mm. long. Flowering in autumn. 1. *S. Drummondii*.

Base of stem densely fibrous-coated. Leaves 1.5–4 mm. wide, glaucous, mostly equaling the scape. Scape slender. Inflorescence 9–15 mm. thick. Bracts acutish to acute. Perianth-segments linear-oblong, thickened, not scarious-margined, entire. Filaments slender, not dilated, 3–4 mm. long. Styles less than 1 mm. long. Flowering in spring. 2. *S. texanum*.

1. SCHOENOCAULON DRUMMONDII A. Gray; Torrey, Bot. Mex. Bound. Surv. 222. 1858–9. "This species was first discovered by Drummond, and is No. 284 of his third Texan collection." Co-type seen in the herbarium of Columbia University at the New York Botanical Garden.

Texas. In the lower coastal plain. Flowers late-September to early-October.

TEXAS. Colorado: sandy soil, three miles east of Alleyton, > September 22, 1913, *F. W. Pennell 5557* (P, Y). Dewitt: roadside near Yorktown, > October 6, 1857, *A. Schott* (Y).

2. SCHOENOCAULON TEXANUM Scheele, Linnaea 25: 262. 1852. "Gesellschaftlich auf trockner Prairie, deren sehr nahe Unterlage Kalkfelsen ist, bei Neubraunfels: *Lindheimer*, April 1846." *Lindheimer 1221*, seen in the herbaria of the New York Botanical Garden, the Academy of Natural Sciences at Philadelphia and the University of Pennsylvania, is probably from the type-locality.

Texas to Chihuahua and San Luis Potosi. Edwards Plateau and southwestward. Flowers April to June.

TEXAS. Hays: San Marcos > Spring, 1898, *S. W. Stanfield* (Y). Kendall: Rocky bluffs, > June, 1885, *J. Reverchon 1607* (P, Y). Kerr: Kerrville > April to June, 1894, *A. A. Heller 1626* (A, Y). Travis: hills, Austin, > May 13, 1872, *E. Hall 644* (Y).

SMILAX, SUBGENUS NEMEXIA (RAF.), IN THE EASTERN UNITED STATES

The subgenus or section of *Smilax* containing the herbaceous-stemmed vines, frequently with beautiful foliage and bearing umbels of lurid green, mostly malodorous flowers—a group of plants commonly known as the carrion-flowers—is one which has long been of especial difficulty to taxonomists. Various writers have held nearly the entire group of species here presented, as well as certain East Asian allies, in one species, *Smilax herbacea*, while others have attempted segregations based upon the shape of the branchlets, the length of the peduncles, the number of primary veins, and other characters which field-study proves too variable for certain use. But it has gradually become apparent

that a number of species may be distinguished upon features at first thought of little moment.

Linnaeus in the first edition of the Species Plantarum recognized two species, *Smilax herbacea* and *S. Pseudo China*. The types of these show that they are identical, and that the widespread glaucous- and glabrous-leaved species of the east is properly called *S. herbacea*. *Smilax tamnifolia* and *S. pulverulenta*, two surprisingly distinct species considering how poorly our books have described them, were added by Michaux. *Smilax lasioneuron* was described by Hooker in 1840 from the Saskatchewan region, and the main innovation of this present revision is the extension of this species eastward to embrace a plant widespread through the Mississippi Valley states. Hooker and his followers have laid emphasis upon the short-peduncled cymes of *S. lasioneuron*, but it requires but slight inspection of a series of any species of this group to show how undependable this character is; indeed, that peduncles should be shortened in specimens of western more arid regions seems natural. Two southern species have been added by Dr. Small, and the present writer describes one species, believed new to science, from Georgia.

The carrion-flowers are here continued as a subgenus of *Smilax*, in deference to the opinion of Mr. John B. Norton, of the United States Department of Agriculture, who is engaged in a study of the entire genus *Smilax*. To him I am indebted for valuable criticism.

My interest in this group extends from 1908, and my collections include most of the species, although several critical southern species have not been obtained.

Anthers about equaling the filaments. Leaves lanceolate to triangular-ovate, usually more or less hastate-lobed at base. Leaves slightly paler and glabrous beneath. Peduncles frequently several in an axil.

Perianth-segments 1.5–2.5 mm. long. Peduncles and pedicels relatively short, the latter less than 10 mm. long. 1. *S. tamnifolia*.

Perianth-segments 4 mm. long. Peduncles and pedicels longer, the latter about 20 mm. long. 2. *S. leptanthera*.

Anthers shorter than the filaments. Leaves ovate to cordate, not hastate-lobed at base.

Mature leaves pale beneath, relatively short-acuminate. Berries dark-blue, glaucous. Perianth-segments broadly lanceolate, 2–5 mm. long.

Leaves glabrous beneath. Bracts on stem below leaves appressed.
Stem 3–5 dm. tall, erect, without tendrils. Leaves all clustered near summit of stem, oblong-ovate, acute. Perianth-segments 2–3 mm. long. Seeds 4.5–5 mm. long, maturing two to a berry. 3. *S. biltmoreana.*
Stem elongated, climbing, with tendrils. Leaves on adult stems all alternate, cordate to ovate, acuminate. Perianth-segments 3–4 mm. long. Seeds 3.5–4 mm. long, maturing three to five to a berry. 4. *S. herbacea.*
Leaves puberulent to pubescent beneath. Bracts on stem below leaves more or less spreading.
Stem elongated, climbing, with numerous tendrils. Peduncles all in the axils of normal leaves. Leaves puberulent to pubescent beneath, acuminate. Seeds maturing three to five to a berry.
Perianth-segments 3.5–4.5 mm. long. Leaves ovate to cordate. 5. *S. lasioneuron.*
Perianth-segments 2–2.5 mm. long. Leaves triangular-ovate. 6. *S. tennis.*
Stem not or slightly elongated, not climbing, with few to no tendrils. Peduncles, at least in part, in the axils of bracts below the leaves. Leaves pubescent beneath.
Perianth-segments 4–5 mm. long. Seeds maturing three to five to a berry. Leaves acuminate, paler beneath. Stems frequently somewhat elongated and with tendrils. 7. *S. ecirrhata.*
Perianth-segments 2.5–3 mm. long. Seeds maturing two to three to a berry. Leaves acute to mucronate, whitened beneath. Stems not elongated, very rarely with tendrils. 8. *S. Hugeri.*
Mature leaves shining-green beneath, strongly acuminate. Berries black, not or scarcely glaucous. Seeds maturing three to five to a berry. Perianth-segments lanceolate, 4–6 mm. long. 9. *S. pulverulenta.*

1. SMILAX TAMNIFOLIA Michx.

Smilax tamnifolia Michx. Fl. Bor. Am. **2**: 238. 1803. "Hab. in Carolina." Description of leaves as "rotundato-obtusis" apparently applies to this. Type not verified.

Coprosmanthus tamnifolius Kunth, Enum. Pl. **5**: 267. 1850.

Nemexia tamnifolia Small, Fl. SE. U. S. 281. 1903.

Moist sandy soil near streams, in the Coastal Plain; Long Island to South Carolina.

Flowers after the other species, in northern New Jersey and on Long Island in late-June and early-July.

NEW YORK. Nassau: Rockville Center, *E. P. Bicknell* > June 27 (Y).

NEW JERSEY. Atlantic: Egg Harbor, *J. B. Brinton* > June 21 (P). Burlington: Atsion, *B. Long 6217* > July 19 (A). Camden: Parkdale, *G. W. Bassett 66* > June 14 (A). Cape May: Court House, *F. W. Pennell 3984* > July 15 (A). Cumberland: Beaver Dam, *B. Long 4943* (A). Gloucester: Repaupo, *E. B. Bartram* > June 23 (A). Middlesex: near Milltown, *N. Williamson* > August (Y). Monmouth: Farmingdale, *N. Taylor 2148* > July 4 (Y). Ocean: Barnegat, *B. Long 5296* < September 29 (A). Salem: Yorktown, *B. Long 4137* (A).

PENNSYLVANIA. Delaware: Tinicum, *T. C. Porter* (Y).

DELAWARE. Sussex: Laurel, *A. Commons* > June 18 (A).

MARYLAND. Dorchester: near Sharptown, *J. P. Otis* (A). Kent: Chestertown, *E. G. Vanatta* < August 3 (A). Prince Georges: Hyattsville, *F. H. Knowlton* > June 27 (U).

DISTRICT OF COLUMBIA. Terra Cotta, *C. S. Pollard 606* (U).

VIRGINIA. Nansemond: Suffolk, *A. A. Heller 925* > June 8–13 (P, U, Y), a large-leaved form.

SOUTH CAROLINA. Aiken: Graniteville, *H. Eggert* > May 21 (M). Clarendon: Manning, *W. Stone 245* > May 21 (A).

2. **Smilax leptanthera** Pennell, sp. nov.

Stem striate, glabrous. Leaves alternate; petioles slender, rounded, narrowly channeled above, 6–7 cm. long; blades triangular-ovate, cordate at base, acuminate at apex, dull-green above, slightly glaucous beneath, glabrous above and beneath. Tendrils about 7 cm. long, stouter than in *S. tamnifolia*, two to an axil. Staminate inflorescence: peduncles 12–15 cm. long; umbels thirty-five- to forty-flowered; pedicels filiform, 18–22 mm. long; sepals six, lanceolate, yellowish green, one-nerved, 4 mm. long, spreading to reflexed-spreading; filaments six, 1.2 mm. long, glabrous; anthers linear, recurved-coiled, 1–1.2 mm. long. Pistillate inflorescence not seen.

TYPE: Warm Springs, Meriwether County, Georgia, collected in flower May 22, 1905, *S. M. Tracy 9257*, in the herbarium of the New York Botanical Garden.

Piedmont Region of central Georgia, known only from the original collection.

Species closely allied to *S. tamnifolia*.

3. **Smilax biltmoreana** (Small) J. B. Norton, comb. nov.

Nemexia biltmoreana Small, Fl. SE. U. S. 281, 1328. 1903.

"Type, Biltmore Herbarium, no. 906b, in Herb. N. Y. B. G." Type seen.

Woodlands; highlands of North Carolina and upper South Carolina.

Flowers in May, fruits in August.

NORTH CAROLINA. Buncombe: Biltmore, *Biltmore Herbarium 906, 906b* > May 4 (B, Y). Cleveland: Kings Mountain, *Biltmore Herbarium 14954 p. p.* (B). Henderson: Flat Rock, *Dr. Shoolbred* (Y). Rutherford: Hickory Nut Gap, *J. K. Small & A. M. Huger* < October 3 (Y).

SOUTH CAROLINA. Greenville: Caesars Head, *L. M. Bragg 3637* < August 26 (S).*

4. SMILAX HERBACEA L.

Smilax herbacea L. Sp. Pl. 1030. 1753. "Habitat in Virginia, Marilandia." Type, a specimen in the Linnaean herbarium, obtained evidently from Gronovius and labeled by him "Smilax annua inermis caule fusco purpureo glabro claviculis plurimis teneris vestito. Ex alis foliorum oritur pedunculus teres glaber semipedalis gerens flores in capitulos globos, collectos." This is evidently a duplicate of Clayton's No. 541 from Virginia, identified both in the Linnaean and Gronovian herbaria as the plant here considered.

Smilax Pseudo China L. *l. c.* 1031. 1753. "Habitat in Virginia, Jamaica." Species clearly aggregate, represented in the Linnean herbarium by specimens written up by Linnaeus as follows, according to a letter of B. D. Jackson: "three sheets pinned together; the first is '11 K Pseudo China,' it is a barren branch, the leaves leathery: the second sheet is written up '11' and seems quite the same plant as the former, but has one berry, the third sheet is of a West Indian species, coll. by Patrick Browne in Jamaica, probably *S. celastroides*." From the wording of the Linnaean description none of these can be considered the type of *S. Pseudo China*, but this would be

* Specimens from the Charleston Museum, Charleston, South Carolina, are indicated by "S."

rather a specimen of Gronovius, also studied by Linnaeus, now in the Gronovian herbarium in the British Museum. The description of Linnaeus is word for word from Gronovius, except for the addition of the phrase "racemis ovato-oblongis," inappropriate for any *Smilax* whatever. "Smilax caule tereti inermi: foliis inermibus, caulinis cordatis, ramorum lanceolatis; pedunculis longissimis," Gronovius, Fl. Virg. 156. 1742, citing Clayton's Nos. 541, 561 and 630, is represented in the herbarium by Nos. 561 and 630 (for No. 541 see above note under *S. herbacea*). These two numbers are identified by Dr. A. B. Rendle as both the same as No. 541, that is, as genuine *Smilax herbacea* L. For the verification of these two Linnaean types I am indebted to Dr. B. Dayden Jackson, of the Linnaean Society of London, and to Dr. A. B. Rendle, of the British Museum.

Smilax inermis Walt. Fl. Carol. 244. 1788. Type, presumably from Berkeley County, South Carolina, not verified.

Smilax peduncularis Muhl.; Willdenow, in Linnaeus, Sp. Pl., ed. 4, **4**: 786. 1806. "Habitat in Canada, Pensylvania." Type not verified.

Nemexia nigra Raf. Neogenyt. 3. 1825. New name for *S. herbacea* L., but apparently intended for the black-fruited *S. pulverulenta* Michx.

Nemexia cerulea Raf. *l. c.* 3. 1825. New name for *S. peduncularis* Muhl.

Coprosmanthus peduncularis Kunth, Enum. Pl. **5**: 264. 1850.

Coprosmanthus herbaceus Kunth, *l. c.* 265. 1850.

Smilax herbacea α Simsii A. DC. Monogr. Phan. **1**: 51. 1878. "*S. herbacea* Sims, Bot. Mag. *pl. 1920*." From figure and description evidently a narrow-leaved form of *S. herbacea*.

Smilax herbacea β peduncularis A. DC. *l. c.* 51. 1878.

Nemexia herbacea Small, Fl. SE. U. S. 280. 1903.

Smilax herbacea crispifolia Pennell, Proc. Acad. Nat. Sci. Phila. **62**: 559. 1910. "Type.—Serpentine, Mineral Hill, Delaware County, Penna., F. W. Pennell 594, coll. Sept. 6, 1908, in Herb. Acad. Nat. Sci. Phila." A narrow, rigid-leaved form of dry soils, probably identical with *S. herbacea Simsii*.

Most woodlands, spring-heads, and near streams; more rarely,

in dry soils, thickets, or open barrens; under the latter circumstances, usually as forma *crispifolia*: New Brunswick to Alabama, west to Indiana and Nebraska.

Flowers in eastern Pennsylvania, New Jersey and southeastern New York late-May to early-June, fruits September to November.

NEW BRUNSWICK. York: Fredericton, *J. Fowler* (U).

ONTARIO. York: Toronto, *Biltmore Herbarium 902b* > June (B).

MAINE. Penobscot: Oldtown, *L. H. Harvey 1014* (U).

NEW HAMPSHIRE. Grafton: Lisbon, *F. Blanchard* (M).

VERMONT. Caledonia: Barnet, *F. Blanchard* (M).

MASSACHUSETTS. Berkshire: Great Barrington, *C. L. Pollard* (U). Bristol: Nonquitt, *E. L. Sturtevant* (M). Essex: Ipswich, *T. Morong* > June 23 (M, Y). Plymouth: Marion, *A. M. Vail* > July (Y).

RHODE ISLAND. Newport: Crescent Beach, Block Island, *Fernald, Long & Torrey 9249* (A).

CONNECTICUT. Fairfield: Greens Farms, *C. L. Pollard 36* > June 7 (U). New Haven: Mt. Carmel, *W. E. Safford 137* > June 5 (U).

NEW YORK. Bronx: east of Van Cortlandt Park, *F. W. Pennell 7039* > June 14 (Y). Delaware: Arkville, *E. N. Harvey* > August (P). Essex: Westport, *N. L. Britton* (Y). Greene: New Baltimore, *N. Taylor 1375* < August 19 (Y). Oneida: Sylvan Beach, *W. R. Maxon 554* (U). Onondaga: Syracuse, *L. M. Underwood* > June (Y). Orange: Guymarch, *F. W. Pennell 6919* (Y). Queens: College Point, *J. Schrenk* > June 3 (Y). Richmond: near Garretson, *A. M. Vail* < October 24 (Y). Rockland: Spring Valley, *P. Wilson* (Y). Sullivan: Mongaup, *F. W. Pennell 6820* (Y). Tioga: Apalachin, *F. E. Fenno 402* > July 27 (Y). Tompkins: Fall Creek, *W. Trelease* > June 13 (M). Ulster: Cragsmoor, *E. M. Farr* (P). Washington: *S. H. Burnham* > July 18 (B). Westchester: Tarrytown Heights, *F. W. Pennell 7001* > June 13 (Y).

NEW JERSEY. Bergen: Alpine, *F. W. Pennell 5729* < September 12 (Y). Burlington: Bordentown, *B. Long 3086* (A). Cape May: Court House, *F. W. Pennell 2601* < August 30 (Y). Essex: Montclair, *J. F. Poggenburg* < September 5 (Y). Gloucester: Woodbury, *C. S. Williamson* > May 25 (A). Middlesex: Milltown, *A. M. Vail* (Y). Monmouth: Farmingdale, *B. Long &*

S. Brown 3545 > May 28–30 (A). Ocean: New Egypt, *J. H. Grove 285** > May 31 (A). Sussex: Andover, *N. L. Britton* < September 28 (Y).

PENNSYLVANIA. Bucks: Penn Valley, *J. Crawford* (U). Chester: Sugartown, *F. W. Pennell 821** < September 23 (A). Delaware: Wawa, *F. W. Pennell 3648**, *3649** > June 9 (A). Fayette: Ohio Pyle, *Brown, Crawford & Van Pelt 29* (A). Lancaster: Pleasant Grove, *J. J. Carter* < August 22 (Y). Lehigh: Slatington, *C. C. Bachman 2413* > June 8 (A). Montgomery: Ashbourne, *B. Long 5835, 5836* > May 28 (A). Northampton: Bangor, *C. S. Williamson* > May 30 (A). Philadelphia: Germantown, *T. Meehan** < September 24 (A). Westmoreland: *P. E. Pierron* > June 10 (U). York: McCalls Ferry, *N. L. Britton* (Y).

DELAWARE. Newcastle: Townsend, *J. B. Brinton* > May 30 (A).

MARYLAND. Allegany: Cumberland, *H. Shriver* (Y). Garrett: Oakland, *F. W. Pennell 6729* (Y). Kent: Chestertown, *E. G. Vanatta* (A).

VIRGINIA. Fairfax: Great Falls, *F. W. Pennell* (Y). Page: Stony Man Mountain, *E. S. & Mrs. Steele 176* < September 1 (B, M, U, Y). Pulaski: Peak Mountain, *J. K. Small* (B, M, U). Rockingham: Mt. Crawford, *A. A. Heller* > May 5–13 (A). Tazewell: Tazewell Peak, *A. H. Howell 437* (U).

NORTH CAROLINA. Guilford: High Point, *Biltmore Herbarium 902c* (B). Haywood: Eagle's Nest, *P. C. Standley 5489* < September 4 (U). Iredell: Statesville, *Biltmore Herbarium 902d* > May 19 (B). Watauga: Blowing Rock, *A. M. Huger* (Y).

SOUTH CAROLINA. Anderson: Pendleton, *L. M. Bragg 3897* (S). Greenville: Paris Mount, *J. K. Small* (Y). Oconee: Clemson College, *H. D. House 2119* (U).

GEORGIA. DeKalb: *H. Eggert* > May 23 (M).

ALABAMA. Lee: Auburn, *F. S. Earle* (Y).

OHIO. Licking: *W. W. Stockberger 902* > June 1 (B).

INDIANA. Steuben: Clear Lake, *C. C. Deam* (U). Wells: Twin Bridges, *C. C. Deam* > June 12 (B).

ILLINOIS. Clinton: Carlyle, *N. M. Glatfelter* (M). Stark: Wady Petra, *V. H. Chase* > May 28 (U).

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* Forma *crispifolia*.

NEBRASKA. Lancaster: Lincoln, *H. J. Webber* (Y).

MISSOURI. Greene: Springfield, *P. C. Standley 9745* < September 2 (U).

5. SMILAX LASIONEURON Hook.

Smilax lasioneuron Hook. Fl. Bor. Amer. **2**: 173. *pl. 187, A*. 1840. "Hab. Carlton House Fort on the Saskatchawan, *Dr. Richardson*." Type not verified, but evidently plant here considered.

Coprosmanthus lasioneuron Kunth, Enum. Pl. **5**: 265. 1850.

Smilax herbacea γ *lasioneuron* A. DC. Monogr. Phan. **1**: 52. 1878.

(?) *Smilax diversifolia* Small, Bull. Torrey Club **25**: 607. 1898. "The original specimens were collected by the writer along the Flint River near Albany, Georgia, May 24–28, 1895." Type, in immature fruit, seen in the herbarium of Columbia University at the New York Botanical Garden. Needs to be studied in flower and mature fruit.

(?) *Nemexia diversifolia* Small, Fl. SE. U. S. 281. 1903.

Nemexia herbacea melica A. Nels. Proc. Biol. Soc. Wash. **17**: 175. 1904. "I take as type Mr. Andrews' specimens from Boulder Cañon [Colorado],—fruit in 1903, flowers (staminate and pistillate) in 1904." Type not seen, but evidently plant here considered.

Nemexia lasioneuron Rydb. Bull. Torrey Club **32**: 610. 1905.

Moist soil, thickets, and along streams; southwestern Ontario and Ohio to Georgia, Alabama, Colorado and Wyoming. Intergrades with *S. herbacea* and with *S. ecirrhata*. Through the Mississippi Valley this species grows much larger and frequently bears peduncles much longer than does the typical form of drier western regions.

ONTARIO. Huron: Wingham, *J. A. Morton 5971* > June 25 (A, Y).

GEORGIA. Dougherty: Albany, *J. K. Small* (Y), type of *S. diversifolia* Small.

ALABAMA. Bullock: Union Springs, *Biltmore Herbarium 14675a* (B).

KENTUCKY. Warren: near Green River, *S. F. Price* (M).

OHIO. Hamilton: Cincinnati, *C. G. Lloyd* > May 23 (M).

INDIANA. Allen: Fort Wayne, *F. W. Pennell 5301* (P). Wells: Bluffton, *C. C. Deam 14* (M, U).

ILLINOIS. Cook: Chicago, *W. C. Ohlendorf* > May 15 (B). Dupage: Naperville, *L. M. Umbach* (U). Kane: Elgin, *E. E. Sherff* < September 14 (M). Lasalle: Starved Rock, *Greenman, Lansing & Dixon 118* (Y). St. Clair: *H. Eggert* > June 14 (M). Stark: Wady Petra, *V. H. Chase* > May 28 (A).

WISCONSIN. Milwaukee: Milwaukee, *H. E. Hasse* (Y).

MINNESOTA. Winona: Stockton, *J. M. Holzinger* < September (U).

NORTH DAKOTA. Benson: Lake Ibsen, *J. Lunell* (Y). McHenry: Towner, *J. Lunell* < September 10 (Y).

SOUTH DAKOTA. Fall River: Hot Springs, *P. A. Rydberg 1052* > June 19 (U, Y). Lawrence: Deadwood, *W. P. Carr 154* (Y). Mellette: White River, *E. J. Wallace* (Y). Washabaugh: *S. S. Visher 2280* < August 22.

IOWA. Decatur: *J. P. Anderson* (M). Johnson: Iowa City, *A. S. Hitchcock* (U).

NEBRASKA. Cedar: St. James, *F. Clements 2609* (U). Lancaster: Lincoln, *G. G. Hedgcock* > May 22 (M). Lincoln: Hershey, *C. D. Mell 41* > May 15 (U). Thomas: Halsey, *L. Krautter* > May 29 (P).

MISSOURI. Barry: Monett, *F. W. Pennell 5359* (P). Cass: *G. C. Broadhead* > June 17 (M). Greene: Springfield, *P. C. Standley 8397* < August 29 (U). Jackson: Independence, *B. F. Bush 529* > June 7 (M). Jasper: Webb City, *E. J. Palmer 473* > June 20 (M). Jefferson: Sulphur Springs, *W. Trelease* < October 23 (M). St. Louis: Valley Park, *F. W. Pennell 5315* (P). Shannon: *B. F. Bush 68* > June 8 (U).

ARKANSAS. Benton: Sulphur Springs, *F. W. Pennell 5364, 5366* < September 3 (P).

OKLAHOMA. Creek: Sapulpa, *F. W. Pennell 5379* < September 7 (P). Kay: *M. White* (Y).

WYOMING. Crook: Sundance Mountain, *A. Nelson 2139* > July 3 (B, M, Y). Fremont: Wind River, *T. A. Williams* (Y). Sheridan: Dayton, *F. Tweedy 2277* < September (Y).

COLORADO. Boulder: Boulder, *F. Daniels 224* (M). El Paso: Colorado Springs, *M. E. Jones 997* > June 18 (U, Y). Larimer: Horsetooth Mountain, *F. W. Pennell 5850* (Y).

6. SMILAX TENUIS Small

Smilax tenuis Small, Bull. Torrey Club 25: 607. 16 D 1898. "The original specimens were collected by Dr. Hale, many years ago in Louisiana." Type seen in the herbarium of Columbia University at the New York Botanical Garden.

Nemexia tenuis Small, Fl. SE. U. S. 281, 1329. 1903. Woods, Louisiana and eastern Texas.

LOUISIANA. *Dr. Hale* > April (Y).

TEXAS. San Augustine: San Augustine, *G. L. Corbett* (U).

7. SMILAX ECIRRHATA (Engelm.) S. Wats.

Smilax herbacea ϵ *ecirrhata* Engelm.; A. DeCandolle, Monogr. Phan. 1: 52. 1878. "Prope Saint-Louis Americae bor. (Engelm.) . . . in h. ber. fol. 89 . . . et in h. Boiss." Type not seen nor verified.

Smilax ecirrhata S. Wats.; A. Gray, Man. ed. 6, 520. 1890.

Coprosmanthus ecirrhatus Chapm. Fl. S. U. S. ed. 3, 504. 1897.

Nemexia ecirrhata Small, Fl. SE. U. S. 280. 1903.

Woodlands; southwestern Ontario to Tennessee, Minnesota and Missouri.

ONTARIO. Huron: Wingham, *J. A. Morton 2283* > June 14 (M, U).

TENNESSEE. Franklin: Cowan, *H. Eggert* > May 7 (M). Knox: Knoxville, *Biltmore Herbarium 906d* > May 1 (B).

KENTUCKY. Bell: Pineville, *Biltmore Herbarium 906c* > May 7 (B). Estill: Irvine, *Biltmore Herbarium 14826* (B).

OHIO. Erie: Groton, *E. L. Moseley* < October 23 (U). Lorain: Amherst, *A. E. Ricksecker* > May 12 (U).

INDIANA. Huntingdon: *C. C. Deam 1953* (Deam). Tippecanoe: Lafayette, *F. W. Pennell 5310* (P). Wells: Bluffton, *C. C. Deam* > May 12 (M, U).

ILLINOIS. Cook: West Pullman, *L. M. Umbach* > May 21 (U). Hancock: —— > May 21 (M). McLean: Bloomington, *G. Vasey* (U). St. Clair: French Village, *H. Eggert* > May 8 (M, Y).

MICHIGAN. Gratiot: Alma, *C. A. Davis* > May 15 (U).

WISCONSIN. Grant: Boscobel, *C. H. Sylvester* > June (Y).

MINNESOTA. Chippewa: Montevideo, *L. R. Moyer* > May 30 (B). Winona: Winona, *J. M. Holzinger* > June (U).

IOWA. Fayette: *B. Fink 614* > June (U). Harrison: *R. Burgess* (Y). Johnson: *T. J. & M. F. L. Fitzpatrick* > May 13 (U).

MISSOURI. Clark: Dumas, *B. F. Bush* (M). Jackson: Courtney, *B. F. Bush* (M). Jefferson: Victoria, *H. Eggert* < August 24 (M, Y).

8. **Smilax Hugeri** (Small) J. B. Norton, comb. nov.

Nemexia Hugeri Small, Fl. SE. U. S. 280, 1328. 1903. "Type, Stone Mt., Ga., *Small*, May 1–18, 1895 (fl.); Hickory Nut Gap, N. C., *Small & Huger*, Oct. 3, 1901, in Herb. N. Y. B. G." Type, "Stone Mt., De Kalb Co., Georgia, J. K. Small, May 1–18, 1895," seen in the herbarium of the New York Botanical Garden. Fruiting specimen cited is *S. biltmoreana*.

Woodlands, Piedmont and upper coastal plain of South Carolina to Alabama.

SOUTH CAROLINA. Aiken: Graniteville, *H. Eggert* (M). Berkeley: Santee Canal, *H. W. Ravenel* > April (S). Eutaw: Nelson's Ferry Road, *L. M. Bragg* (S).

GEORGIA. Clarke: Athens, *Biltmore Herbarium 14826* < July 22 (B). Dekalb: Stone Mountain, *J. K. Small* > May 1–18 (Y), type. Marion: Buena Vista, *R. M. Harper 1409* (M, U, Y).

FLORIDA. Gadsden: *A. W. Chapman* (Y).

ALABAMA. Lee: Auburn, *F. S. Earle & C. F. Baker* < September 8 (Y). Tallapoosa: Dadeville, *C. L. Pollard & W. R. Maxon 138* (U, Y). Tuscaloosa: Tuscaloosa, *E. A. Smith* > April (M).

9. SMILAX PULVERULENTA Michx.

Smilax pulverulenta Michx. Fl. Bor. Amer. **2**: 238. 1803. "Hab. in Canada et Pensylvania." Type not verified, but a specimen of this plant of Michaux's collecting, "No. 29," seen in the herbarium of the Academy of Natural Sciences of Philadelphia, is probably a co-type.

Smilax herbacea var. *pulverulenta* A. Gray.

Nemexia pulverulenta Small, Fl. SE. U. S. 281. 1903.

Rich woods; southeastern New York to North Carolina and

Tennessee; also in southern Missouri. Frequent in the Piedmont region of southeastern Pennsylvania.

Flowers in New Jersey and southeastern Pennsylvania early- to late-May, two weeks to ten days before *S. herbacea;* fruits September to November.

NEW YORK. Bronx: east of Van Cortlandt Park, *F. W. Pennell 7070* (Y).

NEW JERSEY. Bergen: Fort Lee, *F. W. Pennell 7061* (Y). Cape May: Cold Spring, *O. H. Brown* (A). Gloucester: Swedesboro, *C. D. Lippincott* > May 22 (A). Mercer: near Trenton, *A. R. Slack* (P).

PENNSYLVANIA. Bucks: Nockamixon, *A. MacElwee* > May 28 (A). Chester: New Garden Station, *F. W. Pennell 4995* (A). Delaware: Cheyney, *F. W. Pennell 1986* < September 17 (Y). Franklin: Mercersburg, *Detwileer* > June 12 (A). Lancaster: Haines Station, *J. J. Carter* > May 16 (Y). Montgomery: Ashbourne, *B. Long 5824, 5828* > May 21 (A). Northampton: Easton, *T. Seal* > June 2 (A). Philadelphia: Cobbs Creek, *T. S. Githens* > May 14 (A). York: *J. Crawford* (A).

DELAWARE. Newcastle: Stanton, *W. M. Canby* > June 13 (B).

MARYLAND. Cecil: Conowingo, *S. S. Van Pelt & B. Long* > May 21 (A). Montgomery: High Island, *C. L. Pollard 254* > May 19 (U).

DISTRICT OF COLUMBIA. Rock Creek Park, *H. D. House 716* > May 13 (U).

VIRGINIA. Alexandria: Rosslyn, *C. L. Pollard* > May 6 (U). Smyth: Marion, *N. L. Britton & others* > May 22 (Y).

WEST VIRGINIA. Fayette: Thurmond, *Biltmore Herbarium 902e* (B).

NORTH CAROLINA. Buncombe: Biltmore, —— > May 8 (B). Forsyth: Salem, *L. D. von Schweinitz* (A). Halifax: Weldon, *E. B. Bartram* > April 19 (A).

TENNESSEE. Knox: Knoxville, *A. Ruth 154* > May (Y).

MISSOURI. Greene: Gates, *P. C. Standley 9377* < August 26 (U). Howell: Willow Springs, *F. W. Pennell 5339* (P). Jasper: Webb City, *E. J. Palmer 487* (M). Shannon: Monteer, *B. F. Bush 2787* > May 11 (M).

NEW YORK BOTANICAL GARDEN.

Notes on Carex—X

KENNETH KENT MACKENZIE

CAREX ROSEA SCHK. AND ITS ALLIES

Schkuhr's original illustration of *Carex rosea* in the Riedgräser (*pl. ZZZ, f. 179*) is drawn with his usual care and accuracy. Two culms in mature condition are shown. One has four spikes having respectively (commencing with the lowest) eight, seven, five, and five perigynia; and the other has five spikes having respectively eight, eleven, seven, six, and six perigynia. The detailed illustrations of the perigynia show that the body of the perigynium tapers or is but little contracted into the beak, and also that the perigynia are light green in color and are not conspicuously white-hyaline at the orifice. It is further to be especially noticed that the stigmas are slender and not twisted and that the exserted portion is about one third the length of the perigynium at flowering time.

The plant so illustrated is a slender plant with leaf-blades averaging about 1.5 mm. in width. The lower spikes usually have from five to eight perigynia, but the number varies between three and twelve. The most distinctive features, however, are to be found in the shape of the stigmas, slender and not twisted, and in their light reddish brown color. This plant, the genuine *Carex rosea*, is not the plant usually so treated in the manuals, but is the plant which is the basis of many records of *Carex rosea* var. *radiata*. The only work known to me where the distinctive stigmas are alluded to is Boott's Illustrations of the Genus Carex (**2**: 81), where the plant under discussion is treated as var. *minor* Boott of *Carex rosea* and briefly described and figured (*pl. 224*). It is a widely distributed species, ranging from Maine and Quebec, westward to North Dakota and southward to Georgia, Alabama, Mississippi and Louisiana. It flowers late in April or in May, is mature late in May or in June, and in July can be found only in very poor condition.

The plant which has usually been taken for *Carex rosea* is a

much stouter plant of a deeper green color. The leaf-blades average nearly 2.5 mm. in width, and the lower spikes usually have from nine to twelve perigynia, although the number varies between six and twenty. The stigmas are short, thickish and twisted and are dark brownish red in color. The perigynium is abruptly contracted into the beak, is deep green in color, and is conspicuously white-hyaline at the orifice. Like *Carex rosea*, this is a widely distributed plant, ranging from Maine to Manitoba and southward to Alabama, Tennessee and Missouri; and like it, it matures in late May or June. For this species, which is apparently nameless, the name *Carex convoluta* is here proposed.

A third plant of much more restricted range remains for consideration. This is a very slender plant, in which the leaf-blades average little more than 1 mm. in width. The perigynia are very small, mostly 2.5–3 mm. in length, and are ascending or but little spreading. Each spike has but two to six perigynia, and the bract of the lowest spike is as conspicuous as the bract in *Carex trisperma*. In fact, the general aspect of the plant is very much like that of *Carex trisperma*. The stigmas are short and twisted, as in *Carex convoluta*, and the perigynium is abruptly contracted into the beak, as in that species. The perigynia, however, are rather lighter green in color, and less conspicuously white-hyaline at the orifice.

This is a later maturing plant than either of the other two. It blooms late in May or in June, and can be found in good condition in July and August. It is Alleghenian in its distribution and I have seen specimens showing a range from Maine and New York southward to North Carolina and Tennessee. It is the plant treated by Dr. Small (Fl. SE. U. S. 218) as *Carex radiata* and also the plant treated by Dewey (Am. Jour. Arts and Sciences, **10**: 276) and also by Boott (Ill. Car. **2**: 81. *pl. 225*) as *Carex rosea* var. *radiata*. The name "*radiata*," however, goes back to a plant described by Wahlenberg (Kongl. Vet. Akad. Handl. [II.] **24**: 147) under *Carex stellulata*, as *β radiata*, and collected in North America by Rev. Hultgren. As pointed out by Boott (*l. c.* 81) the description of this plant agrees best with *Carex trisperma* or some species of the *C. stellulata* group. Schkuhr referred it as a synonym to his *Carex rosea* (*l. c.* 15), and Dewey, as stated above, referred it to

the plant now under discussion. In the absence of opportunity to examine the original specimen, I am not changing the application of the name. Tuckerman's *Carex neglecta* (Enum. Method. 19) is the oldest specific name for the species, but the name "*neglecta*" had previously been used by other authors for other species. It is interesting to note that both Tuckerman and Wahlenberg (if his name is correctly applied) erroneously placed this species among those with the staminate flowers below the pistillate.

The best characters to separate the three species in question may be contrasted as follows:

Stigmas slender, not twisted, elongated, light brownish red; perigynium tapering or but little contracted into beak, inconspicuously white-hyaline at the orifice. *C. rosea.*

Stigmas stouter, twisted, short, deep brownish red; perigynium contracted into beak, conspicuously white-hyaline at the orifice.

Leaf-blades averaging 2.5 mm. wide; spikes usually with nine to twelve perigynia; perigynia 3.25–4.5 mm. long, widely radiating. *C. convoluta.*

Leaf-blades averaging little more than 1 mm. wide; spikes usually with two to six perigynia; perigynia 2.5–3 mm. long, more ascending. *C. radiata.*

CAREX ROSEA Schk.; Willdenow, in Linnaeus, Sp. Pl. ed. 4, **4**: 237. 1805; Riedgr. Nachtr. 15. *pl. zzz, f. 179.* 1806

Carex rosea var. *minor* Boott, Ill. Car. **2**: 81. *pl. 224.* 1860.

Carex rosea var. *staminata* Peck; E. C. Howe, Rep. New York State Mus. Nat. Hist. **48**: 132. 1895.

Densely cespitose, the culms 2–5 dm. high, slender, 1–1.75 mm. wide at base, aphyllopodic, smooth or slightly serrulate on the angles above, usually exceeding but at times equalled by the leaves, light brownish tinged and fibrillose at base. Leaves with well-developed blades three to six (usually four or five) to a culm, on lower fourth, but not bunched, the blades erect-ascending, 1–2 mm. wide, 3 dm. long or less, light green, flat, strongly minutely serrulate on the margins and on the veins towards the apex, the sheaths tight, not septate-nodulose. Spikes four to eight, androgynous, in an elongate terminal head, 5 cm. long or less, 5–8 mm. wide, the lower three to five separate, the upper three or four aggregated. Staminate flowers apical, inconspicuous, with the four to twelve ascending or at maturity widely radiating perigynia below. Bracts bristle-form, that of the lowest spike conspicuous, 10 cm. long or less, those of the upper spikes much smaller and often rudimentary. Scales triangular-ovate, greenish hyaline,

thin, the midrib not strong, green, the scales obtusish, about width of and half length of body of perigynium. Perigynia soon widely spreading, plano-convex with slightly raised margins ventrally, light green, nerveless or obscurely nerved, roughened on margins above, 3–3.5 mm. long, 1.5 mm. wide, spongy and rounded at base, tapering or somewhat contracted into a bidentate beak, one fourth length of body, inconspicuously hyaline between teeth. Achenes lenticular, broadly obovate, filling perigynia, 1.75 mm. long, 1.25 mm. wide. Style enlarged at base, deciduous. Stigmas two, elongate, slender, usually not twisted, light reddish brown.

SPECIMENS EXAMINED

QUEBEC: Montmorency Falls, *Macoun 67755*, June 28, 1905 (N. Y.).

MAINE: Veazie, *Knight*, June 10, 1905 (K. M.).

NEW HAMPSHIRE: Orange, *Briggs*, 1900 (N. Y.).

MASSACHUSETTS: Chapman herbarium (C.).

NEW YORK: Staten Island, *Britton*, May 25, 1889 (C., P.); New York City, *Morong*, May 28, 1893 (C.); Penn Yan, *Sartwell 25* (C.); Oneida County, *Vasey* (C., P.); Oneida, *Maxon 4552*, July 8, 1909 (N. Y., K. M.); Cooperstown Junction, *Peck*, June, var. *staminata* Peck; Apalachin, *Fenno 491*, May 30, 1898 (N. Y.).

NEW JERSEY: Closter, Bergen County, *Mackenzie 5427*, June 8, 1913 (K. M.); Summit, Union County, *Mackenzie 161*, May 30, 1903 (K. M.); Eagle Rock, Essex County, *Mackenzie 143*, May 17, 1903 (K. M.); Berkeley Heights, Union County, *Mackenzie 2031*, May 30, 1906 (K. M.); Landisville, *Gross*, June, 1878 (P.); Mickleton, *Brinton*, June 15, 1890 (P.); Salem County, *Heritage*, May 28, 1892 (P.); New Egypt, *Grove*, May 21, 1905 (P.); Swedesboro, *Lippencott*, May 20, 1892, June 7, 1893 (P.); Kinkora, *Long 12245*, May 27, 1915 (P.); Vincentown, *Long 12214*, May 25, 1915 (P.); Edgewater Park, *Long 12018*, May 18, 1915 (P.).

PENNSYLVANIA: Easton, *Porter*, June 3, 1890 (C.); New Texas, *Carter*, May 20, 1909 (N. Y.); York Furnace, *Brinton*, May 30, 1892 (P.); Glenolden, *Keller*, June 9, 1895 (P.); Delaware County, *Smith*, May 30, 1898 (P.); Bartram's Garden, *Crawford*, June 3, 1892 (P.); Byberry, *Martindale*, June, 1863 (P.); Haverford, *Smith*, June 11, 1897 (P.); Penn Valley, *Crawford*, June 1, 1899 (P.); Germantown, *Wister*, June 17, 1862 (P.); Philadelphia

County, *Van Pelt*, June 10, 1908 (P.); West Park, *MacElwee*, May 27, 1892 (P.); Wawa, *MacElwee*, June 5, 1892 (P.); Bethlehem, *Schweinitz* (P.); Sellersville, *Fretz*, June, 1883 (P.); Lafayette, *Saunders*, May 28, 1898 (P.); Ryets, *Long*, June 15, 1909 (P.); Penllyn, *Long 915*, June 12, 1909 (P.); Fort Washington, *Long 913, 914*, June 11, 1909 (P.); Bear Hill, *Pennell 3956*, June 28, 1912 (P.); Brookfield, *Pennell 3688*, June 12, 1912 (P.); Bartram's Garden, *Crawford*, June 3, 1892 (P.); Wawa, *Pennell 2083, 2091*, May, 1909 (P.); Phoenixville, *Brinton*, May 25, 1890 (P.); Mt. Bethel, *Bartram*, May 30, 1908 (P.); Slatington, *Bachman 2408*, June 7, 1912 (P.); Mountainville, *Pretz 5325, 5335, 5336*, May 18, 1913 (P.); Allentown, *Pretz 5491*, June 17, 1913 (P.); Hosensack, *Pretz 5407*, May 30, 1913 (P.); Jordan, *Pretz 5512, 5532, 5542*, June 21, 1913 (P.); Bletzel, *Pretz 1775*, May 11, 1909 (P.); Allentown, *Pretz 380*, June 8, 1907 (P.); Mt. Cuba, *Keller*, May 30, 1895 (P.); Lowhill, *Pretz 4659*, June 23, 1912 (P.); Lanark, *Pretz 4475*, June 1, 1912 (P.); Henningville, *Pretz 6532*, May 30, 1914 (P.); Emaus, *Pretz 6595, 6611*, June, 1914 (P.); Bethlehem, *Schweinitz* (P.); Long Pond, *Crawford*, July 3, 1893 (P.); Fulton County, *Stone 242*, June 6, 1905 (P.).

DELAWARE. Belleview, *Commons*, June 2, 1897 (P.); Greenbank, *Commons*, June 4, 1882 (P.).

DISTRICT OF COLUMBIA: *House 792*, May 23, 1905 (N. Y.); *Steele*, May 21, 1898 (K. M.).

NORTH CAROLINA: Chapel Hill, *Ashe*, April (N. Y.); Salem, *Schweinitz* (P.).

SOUTH CAROLINA: Oconee County, *House 2131*, May 13, 1906 (N. Y.).

GEORGIA: Bear Creek, Whitfield County, *Harper 248*, July 18, 1900 (N. Y.); Chokee Creek, Sumter County, *Harper 1116*, July 25, 1901 (N. Y.).

ALABAMA: Auburn, *Earle*, June 2, 1901 (N. Y.).

MISSISSIPPI: Starkville, *Tracy*, April 15, 1888 (C.).

TENNESSEE: Knoxville, *Ruth 927*, June, 1895 (N. Y.).

KENTUCKY: Lexington, *Short*, 1836 (C.).

OHIO: Akron, *Foltz*, May 19, 1889 (N. Y.); Strongsville, *Watson*, May 10, 1896 (K. M.).

ONTARIO: Walpole Island, *Dodge*, May 24, 1910 (K. M.).

MICHIGAN: Agricultural College, *Wheeler*, May 2, 1895 (C.); Mayville, *Dodge*, June 16, 1910 (K. M.); Port Huron, *Dodge*, May and June, 1911, and June, 1915 (K. M.); Long Lake, Lapeer County, *Dodge*, June 2, 1911 (K. M.); Detroit, *Billington*, 1915 (K. M.).

INDIANA: *Clapp* (C.); Helmsburg, *Deam 11168*, June 16 1912 (N. Y.); Vermilion County, *Deam 5791*, May 8, 1910 (K. M.); Decatur County, *Mrs. Deam 8148*, May 13, 1911 (K. M.); Brown County, *Deam 6406, 11168*, May 21, 1910, June 16, 1912 (K. M.); Greene County, *Deam 10723*, May 26, 1912 (K. M.); Ripley County, *Deam 10563*, May 19, 1912 (K. M.); Allen County, *Deam 14244*, May 31, 1914 (K. M.); Wells County, *Deam 14175*, May 17, 1914 (K. M.); Marion County, *Deam 8524, 12905*, May 30, 1911, May 22, 1913 (K. M.); Posey County, *Deam 8347*, May 24, 1911 (K. M.); Martin County, *Deam 12845*, May 21, 1913 (K. M.).

ILLINOIS: Cook County, *Chase*, May 31, 1897 (P.); Decatur, *Clokey*, June 2, 1899 (K. M.); Macon County, *Clokey*, June 4, 1915 (K. M.); "Illinois," *Vasey* (P.).

WISCONSIN: Milwaukee, *Hasse*, June (N. Y.).

MINNESOTA: Chaska, *Ballard*, June, 1891 (C.).

NORTH DAKOTA: Fargo, *Waldron*, June 2, 1900 (N. Y.); Towner, McHenry County, *Lunell*, June 12, 1913 (K. M.).

MISSOURI: Independence, *Bush 717*, June 2, 1895 (C.); St. Louis, *Riehl 394*, June, 1843 (C.); Butler County, *Bush 2659*, May 1, 1905 (K. M., N. Y.); Courtney, *Bush 6751*, May 31, 1912 (K. M., N. Y.); St. Louis, *Glatfelter*, May 15, 1894 (K. M.); Adams, *Mackenzie*, May 23, 1897 (K. M.); Clay County, *Mackenzie 820*, April 27, 1895 (K. M.); Sibley, *Mackenzie 66*, May 29, 1898 (K. M.); Thornton, *Mackenzie 121*, June 5, 1898 (K. M.); Courtney, *Bush 6825*, June 18, 1912 (K. M.); Buckner, *Bush 6785*, June 5, 1912 (K. M.); Cockrell, *Bush 6717*, May 21, 1912 (N. Y., K. M.).

ARKANSAS: Moark, *Bush 2575*, May 1, 1905 (K. M.).

LOUISIANA: *Leavenworth* (C.).

Carex convoluta sp. nov.

"*Carex rosea* Schk." Boott, Ill. Car. **2**: 81 *pl. 223*. 1860.

Carex rosea var. *pusilla* Peck; E. C. Howe, Rep. New York State Mus. Nat. Hist. **48**. 132. 1895.

Densely cespitose, the culms 3–6 dm. high, strict, 2.5 mm. wide at base, aphyllopodic, roughened above, equalling leaves, light brownish tinged and fibrillose at base. Leaves with well-developed blades four to six to a fertile culm, on lower fourth, but not bunched, the sheaths tight, somewhat septate-nodulose, the blades flat, 1.5–3 mm. wide, deep green. Spikes four to seven, androgynous, the upper closely contiguous, the lower strongly separate, with six to twenty perigynia, the staminate flowers few and inconspicuous; lowest bract setaceous, prolonged and often overtopping the culm, the others less developed. Scales broadly ovate, obtuse, thin, white-hyaline with green midvein, about width of and half length of body of perigynium. Perigynia soon widely spreading, plano-convex with slightly raised margins ventrally, deep green, nerveless or obscurely nerved, roughened on margins above, 3.25–4.5 mm. long, 1.75 mm. wide, spongy and rounding at base, abruptly contracted into a bidentate beak, one third length of body, conspicuously hyaline between teeth. Achenes lenticular, orbicular-obovate, filling perigynia, 2 mm. long, 1.6 mm. wide. Style enlarged at base, deciduous. Stigmas two, short, thickish, twisted, dark brown.

My No. 2088 collected June 10, 1906, at Budd's Lake, New Jersey, and preserved in my herbarium may be taken as the type.

SPECIMENS EXAMINED

MAINE: Veazie, *Knight*, June 10, 1905 (K. M.).

NEW HAMPSHIRE: *Blake* (C.).

MASSACHUSETTS: Great Barrington, *Brown*, June 3, 1894 (C., P.); Cambridge, *Fernald*, May 30, 1891 (C.); Dedham, *Forbes*, June 27, 1903 (K. M.); "Mass." *Dewey* (P.).

RHODE ISLAND: North Kingstown, May, 1872 (N. Y.); *Olney*, June (N. Y., P.); Lime Rock, *Batchelder*, June 4, 1913 (P.).

CONNECTICUT: Trumbull, *Eames*, May 20, 1903 (K. M.).

NEW YORK: *Torrey* (C.); Penn Yan, *Sartwell 24* (C.); High Bridge, *Bicknell*, July 5, 1890 (C.); Lake George, *Kemp*, June 1901 (N. Y.); Binghampton, *Clute*, 1895 (N. Y.); Apalachin, *Fenno 492, 500*, May 1898 (N. Y.); Portage, *Peck*, var. *pusilla* Peck (N. Y.).

NEW JERSEY: Budd's Lake, *Mackenzie 2088*, June 10, 1906 (K. M.); Cranberry Lake, *Mackenzie 732, 1295*, June 12, 1904, May 30, 1905 (K. M.); Mickleton, *Heritage*, May 18, 1892 (P.); Mickleton, *Brinton*, June 15, 1890 (P.); Glassboro, *Long 3419*,

May 16, 1910 (P.); Farmingdale, *Long & Brown 3702*, May 28, 1910 (P.); Bordentown, *Long 12468*, June 11, 1915 (P.); Mullica Hill, *Long 12390*, June 4, 1915 (P.); Sharptown, *Long 12354*, June 1, 1915 (P.).

PENNSYLVANIA: York County, *Glatfelter*, June, 1895 (K. M.); Llewellyn Mills, *Pennell 5065*, July 16, 1913 (P.); Byberry, *Martindale*, June, 1865 (P.); Rock Hill, *Keller*, June 19, 1892 (P.); Lafayette, *Keller*, June 2, 1895 (P.); Spring Mount, *Van Pelt*, June 12, 1908 (P.); Gwynedd, *MacElwee 2322*, June 8, 1902 (P.); Green Lane, *Allebach*, May, 1911 (P.); Wernersville, *Lightfoot*, July 6, 1892 (P.); Easton, *Porter*, May 28, 1895 (P.); Rock Hill, *Saunders*, May 30, 1898 (P.); Chestnut Hill, *Porter*, June 14, 1898 (P.); Lancaster, *Long*, June 22, 1909 (P.); Revere, *Long*, July 6, 1909 (P.); Churchtown, *Long*, June 17, 1909 (P.); Bustleton, *Long*, June 15, 1909 (P.); Willow Grove, *Long 3778*, June 1, 1910 (P.); Chester Heights, *Pennell 5045*, June 21, 1913 (P.); Montgomery County, *Long 8274*, May 18, 1913 (P.); Limeport, *Pretz 5646, 5709*, June and July, 1913 (P.); Locust Valley, *Pretz 5675*, July 4, 1913 (P.); Mill Hill, *Pretz 5431*, May 30, 1913 (P.); Mountainville, *Pretz 1855, 5342, 6650, 6776*, May 29, 1909, May 18, 1913, June, 1914 (P.); Jordan, *Pretz 5545*, June 21, 1913 (P.); Jordan Creek, *Pretz 5566*, June 22, 1913 (P.); Vera Cruz, *Pretz 3472a, 5621*, June 4, 1911, June 29, 1913 (P.); Hosensack, *Pretz 4828B*, July 21, 1912 (P.); Treichler, *Pretz 4583*, June 22, 1912 (P.); Dillinger, *Pretz 3487*, June 4, 1911 (P.); Emaus, *Pretz 6583*, June 6, 1914 (P.); Spring Valley, *Pretz 4535*, June 9, 1912 (P.); Fleetwood, *Long 12603*, June 27, 1915 (P.); Laurel Hill, Somerset County, *Brown & Saunders*, May 30, 1899 (P.); Tannersville, *Brown*, July 4, 1901 (P.); Easton, *Porter*, 1891 and 1895 (C.); Conewago, *Small*, May 28, 1889 (C.).

DELAWARE: Mt. Cuba, *Brinton*, June 22, 1890 (P.); Greenbank, *Commons*, June 17, 1882 (P.).

DISTRICT OF COLUMBIA: *Steele*, May 15, 1896 (K. M.); *Williams*, May 30, 1899 (K. M.).

VIRGINIA: Smyth County, *Britton & others*, May, 1892 (C., P.); June 1, 1892 (C., K. M.); Wytheville, *Shriver*, 1874 (P.).

NORTH CAROLINA: *Hunter* (C.); Biltmore, *Biltmore Herbarium 263a*, June 3, 1896 (N. Y.).

SOUTH CAROLINA: Clemson, *House 3389*, May 22, 1907 (N. Y.).

ALABAMA: *Buckley*, May, 1841 (C.); Point Clear, Baldwin County, *Mohr*, April 29, 1879 (N. Y.).

TENNESSEE: Franklin County, *Eggert*, June 8, 1897 (N. Y.); Prospect, *Gattinger*, May 18, 1883 (N. Y.).

KENTUCKY: *Short*, in 1842 (C., N. Y.); Lexington, *Peter*, May, 1834 (P.).

OHIO: *Frank 55*, 1835 (C., N. Y.).

ONTARIO: Guelph, *Klugh*, July 9, 1905 (K. M.); Ontario, *J. M. Macoun*, June 12, 1891 (C.).

MICHIGAN: Cassapolis, *Wheeler 22*, June 2, 1890 (C.); Agricultural College, *Wheeler*, May 6, 1895 (C.); Olivet, *McClatchie*, June 3, 1887 (N. Y.); Flint, *Clarke* (P.); Tuscola County, *Dodge*, June 20, 1910 (K. M.): Mackinack County, *Dodge*, July 1, 1912 (K. M.); Port Huron, *Dodge*, June 6, 1911 (K. M.); Lapeer County, *Dodge*, June 2, 1911 (K. M.).

INDIANA: Greencastle, *Underwood*, June, 1893 (N. Y.); Laporte County, *Deam 8745*, June 17, 1911 (K. M.); Noble County, *Deam 6786*, June 20, 1910 (K. M.); Putnam County, *Deam 6506* (K. M.); Clarke County, *Deam 6476*, May 25, 1910 (K. M.); Vermilion County, *Deam 5841*, *5841a*, *5842*, May 8, 1910 (K. M.); Wells County, *Deam 14181*, May 17, 1914 (K. M.); Ripley County, *Deam 10588*, *10606*, May 19, 1912 (K. M.); Hendricks County, *Deam 10885*, June 1, 1912 (K. M.); Elkhart County, *Deam 10998*, June 4, 1912 (K. M.); Howard County, *Deam 5913*, *5950*, May 15, 1910 (K. M.); Brown County, *Deam 6560*, June 5, 1910 (K. M.); Wayne County, *Deam 13146*, June 4, 1913 (K. M.); Jackson County, *Deam 12719*, May 11, 1913 (K. M.); Johnson County, *Deam 11082*, June 8, 1912 (K. M.); Hamilton County, *Mrs. Deam 10540*, May 19, 1912 (K. M.); Lagrange County, *Deam 15945*, June 5, 1915 (K. M.).

WISCONSIN: Milwaukee, *Hasse*, June 1, 1880 (N. Y.); Madison, *Hale* (P.).

ILLINOIS: Mt. Carmel, *Schneck*, May 15, 1880 (C.); Peoria, *McDonald*, June, 1903 (N. Y.); Lasalle County, *Greenman & others. 59*, June, 1909 (N. Y.).

MINNESOTA: Center City, *Taylor*, June, 1892 (C.).

IOWA: Ames, *Ball 15*, June 4, 1898 (N. Y.); Charles City,

Arthur, May 16, 1875 (N. Y.); Fayette, *Fink*, June, 1895 (N. Y.); Iowa Lake, *Cratty*, June 8, 1881 (N. Y.); Armstrong, *Cratty*, June 22, 1898 (N. Y.); Marshalltown, *Pammel 384*, May 1, 1897 (K. M.).

MISSOURI: Monteer, *Bush 4673*, *4689*, May 24, 1907 (K. M.); Swan, *Bush 4513*, *4513a*, May 17, 1907 (K. M.); Martin City, *Mackenzie*, June 13, 1900 (K. M.); Monteer, *Bush 2802*, *2870*, May, 1905 (K. M.); Burge Park, *Mackenzie*, May 16, 1896 (K. M.); Courtney, *Mackenzie*, May 23, 1896 (K. M.); Courtney, *Bush*, May 18, 1891 (C., P.), and *6810*, June 10, 1912 (K. M., N. Y.); Swan, *Bush 2914*, May 19, 1905 (K. M., N. Y.).

KANSAS: Leavenworth County, *Hitchcock 867*, 1896 (N. Y.); Quindaro, *Mackenzie*, May 30, 1897 (K. M.).

NEBRASKA: Ponca, *Clements 2557*, June 15, 1893 (C.); Lincoln, *Webber*, June, 1886 (C.); Ashland, *Williams*, 1890 (K. M.).

SOUTH DAKOTA: Bigstone, *Williams*, June, 1895 (K. M.).

MANITOBA: Portage la Prairie, *Macoun 72775*, June 9, 1906 (N. Y.).

CAREX RADIATA (Wahl.) Small, Fl. SE. U. S. 218. 1903

Carex stellulata β. C. radiata Wahl. Kongl. Vet. Akad. Handl. (II.) **24**: 147. 1803.

Carex rosea β. radiata Dewey, Am. Jour. Sci. **10**: 276. 1826.

Carex neglecta Tuckerman, Enum. Method. 19. 1843.

"*Carex disperma* Dewey" Kunze, Riedgr. Suppl. 131. *pl. 33*. 1840–50.

Densely cespitose, the culms 2.5–5 dm. high, very slender, 1.5 mm. thick at base, weak, aphyllopodic, roughened above, equalling leaves, light brownish tinged and fibrillose at base. Leaves with well-developed blades four to six to a fertile culm on lower fourth, but not bunched, the sheaths tight, not septate-nodulose, the blades flat, 1–1.75 mm. wide, light green. Spikes mostly four, androgynous, the two upper closely contiguous, the lower strongly separate, with two to six perigynia, the staminate flowers few and inconspicuous; lowest bract setaceous, erect, prolonged and often overtopping the culm; the others less developed. Scales ovate, obtuse, thin, white-hyaline with green midvein, about width of but shorter than body of perigynium. Perigynia at first erect, at maturity more or less strongly spreading, plano-convex with slightly raised margins ventrally, deep green, nerveless or obscurely nerved, roughened on margins above,

2.25–3 mm. long, 1.5 mm. wide, somewhat spongy and rounding at base, abruptly contracted into a bidentate beak, half length of body, hyaline between teeth. Achenes lenticular, orbicular-obovate, filling perigynia, 1.5 mm. long, nearly as wide. Style enlarged at base, deciduous. Stigmas two, short, twisted, dark reddish brown.

SPECIMENS EXAMINED

MAINE: Orono, *Briggs*, June, 1892 (N. Y.); Orono, *Fernald*, July 1, 1891 (C.).

NEW HAMPSHIRE: East Andover, *Briggs*, 1900 (N. Y.).

VERMONT: Middlebury, *Brainerd*, June 20, 1880 (P.).

MASSACHUSETTS: Plainfield, *Porter* (C.); Ashfield, *Forbes*, August 19, 1904 (K. M.); North Adams, *Fernald & Long 9017*, June 23, 1913 (P.); "Mass." *Nuttall* (P.).

RHODE ISLAND: *Olney* (N. Y., K. M.).

CONNECTICUT: *Barratt* (N. Y.); West Goshen, *Underwood*, June 29, 1891 (C.).

NEW YORK: Oneida County, *Vasey* (N. Y., K. M., P.); Hunter, Catskill Mountains, *Britton*, August 1, 1898 (N. Y.); Tannersville, *Vail*, July 16, 1892 (C.); Preston, *Coville*, June 28, 1886 (K. M.).

NEW JERSEY: Water Gap, *Mackenzie 5306*, September 28, 1912 (K. M.); Moe, Passaic County, *Mackenzie 6005*, July 5, 1914 (K. M.).

PENNSYLVANIA: Pike County, *Brown & Saunders*, July 9, 1899 (P.); Nockamixon, *MacElwee*, May 28, 1893 (P.); Rockdale, *Krout*, June, 1877 (P.); New Jerusalem Church, Lehigh County, *Hamm 839*, August 14, 1911 (P.); Rockdale, *Van Pelt*, July 25, 1909 (P.); Hoffman, *Pretz 7752*, August 8, 1915 (P.); Rockdale, *Pretz 2019*, July 25, 1909 (P.); Bethlehem, *Schweinitz* (P.); Tobyhanna, *Brown*, July 2–4, 1893 (P.); Ararat, Susquehanna County, *Saunders*, July 8–20, 1900 (P.).

VIRGINIA: Peaks of Otter, *Curtiss*, June 28, 1871 (N. Y.), *Brown & others*, May and June, 1890 (C., P.); Smyth County, *Britton & others*, June, 1892 (C.); Grayson County, *Britton & others*, June 15, 1892 (C., K. M.); Mountain Lake, *Britton & others*, June 1, 1890 (C.); Pond Mountain, *Small*, June 11, 1892 (C.); Luray, *Steele*, August 11, 1901 (N. Y.).

KENTUCKY: Big Black Mountain, Harlan County, *Kearney 156*, August, 1893 (C.).

TENNESSEE: Thunderhead Mountain, 6711 ft. alt., *Ruth 928*, July, 1894 (N. Y.), and *30*, June, 1894 (K. M.).

NORTH CAROLINA: Mt. Mitchell, *Biltmore Herbarium 206b*, Junei 8, 1898 (N. Y.); Craggy Mountain, *Biltmore Herbarium 206a*, July 9, 1897 (N. Y.); Macon County, *Buckley* (C.); Swain County, *Beardsley & others*, July, 1891 (C.); Watauga County, *Small & Heller 265*, June 24, 1891 (C., P.); Mt. Mitchell, *Biltmore Herbarium 4974c*, June 20, 1898 (N. Y.).

INDEX TO AMERICAN BOTANICAL LITERATURE

1909-1916

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card issue should be addressed to the Treasurer of the Torrey Botanical Club.

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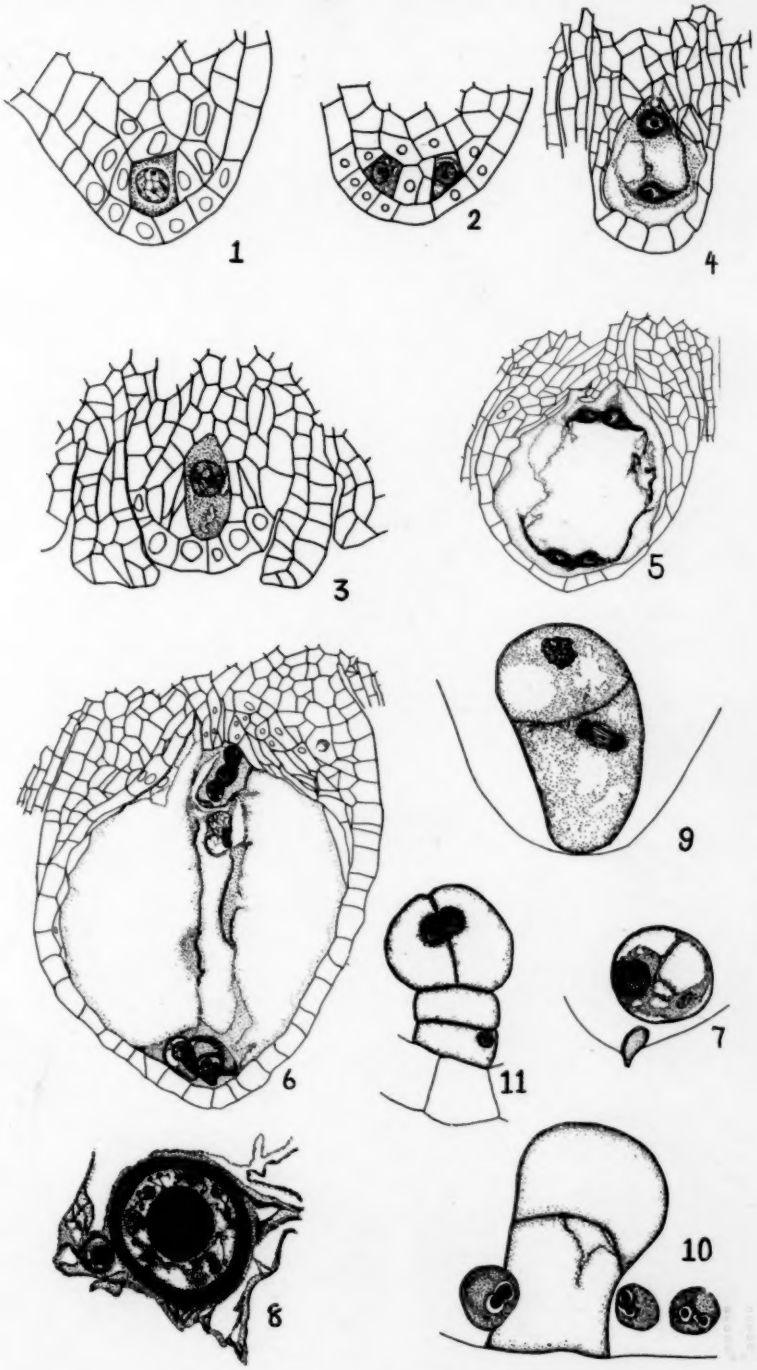

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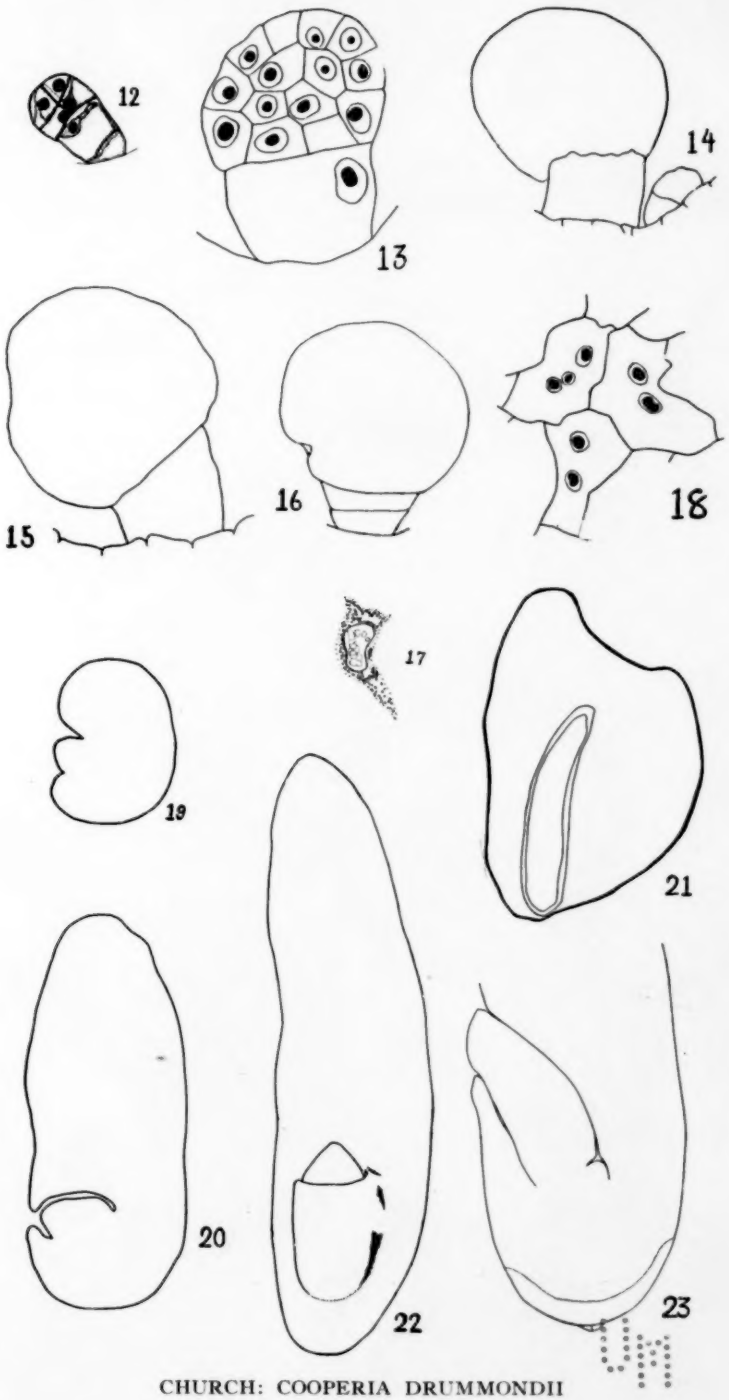

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